SYSTEMATIC GEOGRAPHY.

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1. *Geography lacks System.*—Geography has not as yet taken so much advantage from a systematic classification of the facts with which it is concerned as is the case with the biological sciences. The botanist or the zoölogist is greatly aided in observation and in description by the effort to refer every organic individual to its proper place in a comprehensive scheme of classification, whereby its relationships and its contrasts are most concisely set forth; and if he is for a time puzzled by a new species or by a form of uncertain position, he does not for a moment waver in his belief in the value of the principles of classification, but draws encouragement from the aid that it has already given him and perseveres until the systematic position of the new or uncertain species is made clear. The geographer on the other hand makes no such habitual use of

systematic methods. The classification that he uses is immature and imperfect; many classes of geographical problems are as yet hardly classified at all. It is with the intention of showing the need, the possibility and the value of systematic work in geography that this essay is presented.

If a geographer should come upon such an item as one of the narrow flood-plain scrolls sketched in Fig. 1, he might treat it in either one of two ways. He might describe it empirically as a local item of earth form, unrelated to all other items; or he might more or less consciously refer it to some appropriate place in a general scheme of geographical classification, whereby its origin and relationships would be made manifest. The geographer at

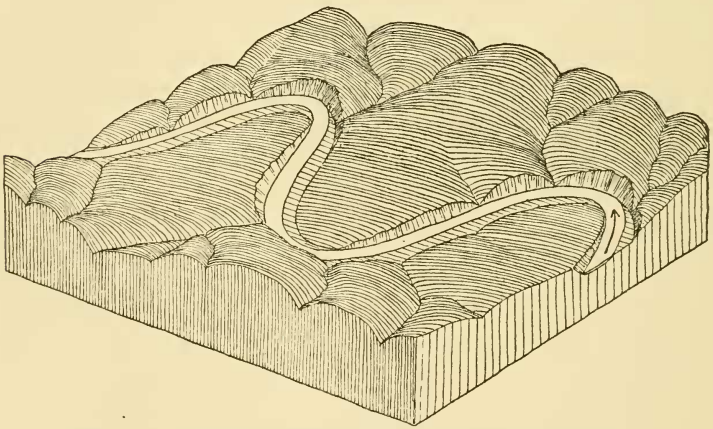

FIG. 1. A meandering valley with narrow flood-plain scrolls.

present generally attempts to pursue the second plan, as would be indicated by the use of such a descriptive phrase as "a narrow strip of flood-plain"; for the term "flood-plain" has a technical meaning and suggests that the observed example belongs with other more or less similar examples in a recognized class of geographical forms. If however we should question different geographers as to the relation of narrow flood-plain scrolls to flood plains of other forms, and as the rest of the scheme of classification in which flood plains form a single group, no approach to agreement would be found; for the venerable subject of geography has not yet established a well-coördinated system of classification for the

facts with which it is concerned. The classifications commonly employed are too often inconsistent, incomplete and immature—inconsistent in their different parts even as to the larger principles upon which their subdivisions are based; incomplete in not including nearly all the categories of facts which properly belong under geography; and immature in making too often only a small advance over the method and terminology of school days. The narrow flood-plain scrolls, such as are shown in the figure above, and such as exist in remarkably perfect development in the valley of the North Branch of the Susquehanna, would according to the methods of geographical description and classification usually current be given no sufficient statement as to their form, no adequate explanation as to their origin, no appropriate discussion as to their correlation with adjacent features, and no systematic treatment as to their share in constituting the physical environment of their organic inhabitants. Yet the flood-plain scrolls deserve due consideration in all these respects from any one who would clearly portray the geography of their district. Lack of consideration is not due to any serious difficulty that inheres in the systematic treatment here suggested, but simply to the habitually unsystematic character of geographical study.

It is the same with the organic items of the broad subject of geography. A farm or a village, a thicket or an ant-hill, a city on a bay or a road over a mountain range is too often mentioned as if it were an isolated and ultimate fact, rather than as if it were a member of a class, exhibiting the peculiar response of certain kinds of organisms to their surroundings. Correlation between the environed organism and the physical environment is coming to be recognized as an essential part of geographical study, yet correlation is not habitual in the treatment of the organic division of the subject by those who would wish to be considered geographers; and as to classification of the correlations, there has as yet been made hardly a beginning. Still it can hardly be doubted that all organic responses are susceptible of a reasonably systematic grouping in relation to one another, and that every example would be better seen and appreciated if it were viewed in association with its fellows.

2. *The Value of Systematic Geography.*—It may be urged with much confidence that fuller attention to such items as narrow flood-plain scrolls, or to any one of the innumerable organic examples

that might be instanced, would be secured if geographers were habituated to treat all such items as forming parts of a whole, and to place every item in its proper place with respect to all others in a well-arranged system of classification. It is sometimes the case that the labors of the systematist are decried; but it is only when systematization is the master and not the servant of the investigator that it merits condemnation. The orderly arrangement of the events in the earth's long history is the goal of all geological study; for the facts of physical and structural geology must be dated in terms of geological chronology if their true relation is to be appreciated. So with geography: it stands to reason that any logical scheme for the classification of all the elements that constitute the content of geography would be of practical value in treating the innumerable items with which the geographer is concerned. The object of such an arrangement would not be to put facts away, out of sight, but to expose them in orderly fashion so that they can be most readily seen, to arrange them so that they shall illuminate and be illuminated by their neighbors. A result of double value would thus be gained. Every fact would be seen in logical relation to its fellows, and its fellows would be seen in logical relation to it. The attention of the geographer would thus be directed to a broadened consideration of correlations, instead of being allowed to limit itself to a narrow view of isolated and unrelated items. The work of the observer in the field would be greatly aided by the presence in his mind of an ideally full treatment for every kind of item that he encounters; unless indeed he has the good fortune to come upon an item previously unknown, and in that case the habit of systematic description already formed would come to his assistance in the effort to gain a full understanding of the novel element. There is no other means by which the general principles, the underlying philosophy of geography, can be so clearly set forth as by systematic classification.

3. *The Content of Geography.*—The first step in an attempt at classification requires an understanding as to the content of geography as a whole. Here at the very outset no general agreement can be expected to-day; but it is well to note that general agreement will probably be reached by following the trend of the progress by which geography has passed through two stages, now to enter upon a third stage of development. A hundred years ago, geography was the study of the earth and its inhabitants; explanation then

made a very small part of description, and even a teleological correlation of the organic and the inorganic divisions of the subject had not been introduced as a well-defined characteristic of its methods. With the progress of science during the nineteenth century, explanation came to constitute a larger and larger share of the descriptive chapters of geography; and from the time of Ritter, geography has been very commonly defined as the study of the earth in relation to its inhabitants, the relationship being exposed during the second stage of progress in the light of teleology, of which abundant traces may be seen to this day.

The third stage of geographical progress is marked by the introduction of two new principles during the last third of the nineteenth century. It thus came to be recognized that explanation must be systematically sought for in every department of the subject; for river courses as well as for winds and ocean currents; for moraines as well as for sand dunes; and it is further recognized that the relationship existing between the earth and its inhabitants must be explained under the broad principles of evolution. The earth with its lands and waters was not arranged for the convenience of its inhabitants; its inhabitants have had to learn, by more or less conscious experiment, to live upon the earth as they found it. As in so many other sciences, the evolutionary philosophy is of enormous practical import in geography. If the earth has not been expressly fitted to the convenience of its inhabitants, but if the inhabitants have had gradually to fit themselves to their slowly changing surroundings, how essential is it that we should study those surroundings minutely, with all the intelligence that has been awakened in the later days of man's history, in order to take the best advantage of them; how important is it that we should look carefully into the real nature of things, so as to avoid an environment that involves a hopeless struggle against the forces of nature, and to choose instead an environment in which the inexhaustible forces of nature will work to our advantage. With the adoption of the evolutionary philosophy, the content of geography can no longer be defined as the relation of earth and man, but as the relation of earth and life. The cleared roadway of a colony of pillaging ants becomes as properly a subject of geographical study as a railroad that connects centres of human population. Elementary geography may still deal with the simplest salient facts and place man conspicuously in the foreground; more advanced geography may include

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examples of greater complexity, but always selecting important rather than trivial matters; but the investigator must study the trivial items along with the greater ones, and all must be duly scrutinized, described and classified.

4. *Physiography and Ontography.*—Let it then be here agreed that the whole content of geography is the study of the relation of the earth and its inhabitants. We thus see two prime divisions of the subject. One includes all the elements of the physical environment of life; the other all those responses which life has made to its environment; and in accordance with modern methods both of these divisions should be treated under the explanatory principles of evolution, inorganic and organic. It is the element of relationship between the physical environment and the environed organism, between physiography and ontography (to coin a word), that constitutes the essential principle of geography to-day. Mature, fully developed geography therefore involves the study of physiography and ontography in their mutual relations. Treated otherwise, the divisions of the subject lose coherence; they fall apart and are gathered up by various other sciences. It is only when they are bound together by the element of relationship that they constitute a reasonably connected body of study, as well unified a science as any other. In support of this principle, let us turn aside to note—as others have done—how largely the principle of relationship is serviceable in classifying the sciences.

5. *Comparison of Geography with other Sciences.*—All terrestrial substances, inorganic and organic, the study of whose relationships constitutes geography, are also the proper subject of study in relation to composition by the chemist: rock, water, air and organisms are all to be analyzed and classified as compounds. Again, all the activities in the world of geography are the appropriate subject of study in relation to energy by the physicist. Moreover, as fast as geography, chemistry, physics and the other sciences advance, their progress should be duly chronicled by the historian; for it is a sad mistake to imagine that the whole content of history is only the "politics of the past." From the discovery of America by Columbus to the discovery of a narrow flood-plain scroll on the upper Susquehanna by an early backwoodsman; from the migration of races across continents to the settlement of miller by a waterfall, there is no discontinuity. The historian must regard all such facts, great and small, as pertinent to his study of the sequence

of human events, even though he can make explicit mention of the greater ones only. The physicist must bring the behavior of a river in making its flood plains and of a stone in falling from a cliff under the domain of physical law, although he may not make mention of every flowing stream and of every falling stone in his systematic text-book. The chemist must discover all the kinds of changes in composition caused by the weathering of rocks; he must learn the composition of everything from the miller to his flour and his millstone. It is therefore not in terms of the things studied that a science can be defined, but only in terms of the relationships involved in the study. The things with which the geographer is concerned may also concern the physicist, the chemist and the historian; but as far as these things enter into the relation between the earth and its inhabitants, they constitute the content of geography.

It is particularly in relation to geology that geography has been needlessly confused. Geology is essentially a historical study; it is for the earth what history is for man. Geography, on the other hand, is distinctly not a historical study; what is often called historical geography might be much better called geographical history. Geography considers the relationship of existing conditions, inorganic and organic; and as far as the dimension of time enters into geographical methods, it is introduced not for the purpose of studying the sequence of events that lead up to existing phenomena—that belongs to geology or to history—but for the purpose of better seeing the existing phenomena themselves, as will be more fully shown below. Thus understood, geology and geography are closely related; it may be fairly said that geology culminates in geography, and that all geology consists of a sequence of paleogeographies. Surely, no geologist would dismiss the present condition of the earth and its inhabitants from consideration as constituting the last page in the recent chapter of historical geology. Ocean navigation and cable laying, city growth and railroad building deserve a place in the geology of the recent period on exactly the same ground that trilobite tracks and dinosaur prints belong in the record of the past. Conversely, every geographer should conceive all the geological history of the earth as involving a succession of geographies, horizontally stratified with respect to a vertical time line. All the processes of slow erosion, of volcanic eruption, of rising and falling lands, of organic adaptations, formed elements of

these successive paleogeographies, just as the slow depression of the Netherlands, the eruptions of Vesuvius and Pelee, the washing of neglected fields, and the migrations of Europeans into the open lands of America constitute elements of the geography of to-day.

The science of geography is therefore, like all other sciences, concerned with the relationships of things which, when they enter into relationships of other kinds, belong under other sciences, and which are known to be pertinent to geography not by their own qualities but by the relationship in which they are considered. It is the classification of the elements of a subject thus constituted that we have to consider.

It is not my purpose however to present here a detailed statement of a classification, but rather to set forth the nature of a classification which might, when expanded in a more technical geographical publication, afford suitable categories for all kinds of geographical facts. It will suffice therefore to indicate briefly the larger divisions of the subject, and to pursue only one of these divisions, namely the lands, into details.

6. *Subdivisions of Physiography.*—Geography as a whole has already been shown to consist of two chief divisions, physiography and ontography. Physiography has four chief subdivisions—the earth as a globe, the atmosphere, the oceans and the lands. Let us set aside for the present all but the last subdivision. The lands should first be treated as a whole, and their contrast with the other exterior parts of the earth considered. A notable contrast, of great significance in its ontographical relations, is found between the lands covered by the atmosphere, and the sea floors covered by the oceans. The latter are monotonously cold, dark and quiet, as well as remarkably uniform in shape and constitution; while the former exhibit a variety of forms, such as high and low, smooth and rugged, flat and steep, and experience a succession of changing conditions, such as wet and dry, calm and windy, hot and cold. The general weathering and washing of the lands, whereby their waste goes to make the gain of the sea floors, results in their being scored by many branching systems of valleys; this highly specialized kind of inequality being as significantly characteristic of the land surface as is smoothness of the blanketed sea floors. There is nothing new in all this, but geographers too generally fail to recognize these general features of the lands as the determining physical environ-

ments in response to which many an organic condition has been called forth.

The lands need subdivision into relatively small areas, for their forms vary greatly from place to place. It has long been habitual with geographers to describe and classify these forms empirically; but there is to-day a well-defined trend of opinion in favor of rational, evolutionary or explanatory description and classification, even though this more modern method has not yet found general acceptance in practical exploration. An eclectic system of subdivision, based on the suggestions of various writers, may be briefly stated as follows:

7. *Classification of Land Forms.*—Land forms are classed first as to kind, according to their rocky structure; thus one area may be of horizontal structure; a second may consist of broken and tilted blocks; a third may have a domed structure; a fourth may be folded; a fifth may be of volcanic origin, and so on.

Each kind of land form is then to be further classified according to its stage in the cycle of erosion, to which it is introduced by initial processes of deformation and (relative) upheaval, and through which it progresses by the action of weathering and washing towards an ultimate goal of obliteration in a featureless plain close to sea level, or in a smooth platform at an undetermined depth beneath sea level. There is to-day abundant warrant for asserting that the sequence of developmental stages through this destructive cycle of erosion is remarkably systematic, and that very effective description of land forms may be given by characterizing them simply as young, mature or old. This is therefore not a matter of abstract theory, but of practical convenience to the field geographer.

There is need of distinction between the inert land mass, offered to erosion by the telluric forces of upheaval, and the physiographic agencies by which the erosion is accomplished; the chief of the latter being river systems. There is again need of discriminating the forms assumed by the slow-moving waste of the land on the way to the sea, from the inert land mass on the one hand, and from the more active agencies of erosion on the other hand. With respect to the active water streams, the land waste is relatively inert and passive; but with respect to the inert underlying rock mass, the waste may be treated as part of the superficial river system. The latter treatment brings forth many interesting homo-

logies between water streams and waste streams, and from this arises a simple terminology for waste forms by which the power that words have of suggesting things is greatly increased.

It is still further necessary to distinguish between the several kinds of agencies that are chiefly responsible for erosion, as determined by climatic conditions. Thus far, a normal climate has been assumed, of sufficient rainfall to fill all depressions to overflowing and of insufficient snowfall to form glaciers. On one side of this norm there is the arid climate, where rainfall is small and vegetation scanty, and where the wind therefore takes a significant part in the work of shaping the land surface; here the whole surface swept by the wind corresponds to the bed of a water stream. On the other side is the glacial climate, where precipitation is chiefly in the form of snow and where drainage is chiefly in the form of glaciers; here the slender and nimble water streams of the normal climate are replaced by clumsy and sluggish ice streams, with the result of greatly increasing the proportion of drainage channel to drainage area.

Finally the border of the lands where they dip under the sea is attacked by waves and currents and appropriately carved; the cycle of shore erosion being just as systematic and helpful as the cycle of rain-and-river erosion. Each kind of land form, as determined by its rocky structure, exhibits forms peculiar to itself and appropriate to their stage of littoral erosion. Here, as in the normal and special cycles of subaerial erosion, such terms as young, mature and old are highly suggestive because of the systematic correlations of various elemental forms that they imply.

This system of classification is at present by no means fully developed, for it has been directly applied to but a relatively small part of the lands; yet it is so efficient where it has been applied that there is every reason to expect that it will be all the more efficient when it shall have been more widely applied and more fully developed. Some of its essential features may now be given fuller exposition.

8. *Physiographic Classification involves Explanation.*—Explanation of origin is regarded as essential to a complete description in this evolutionary method of physiographical classification. Not only must forms of simple and manifest origin, such as sand dunes and stream gorges, be explained; but all forms, difficult and obscure as their origin may be, must if possible be brought under

explanatory treatment. Geographers have been slow to accept this responsibility. True, they have long explained volcanoes by eruption, because eruptions have been witnessed; yet they have been habitually inattentive to the radial gorges by which extinct volcanoes are scored. While gorges and water-gaps are still sometimes ascribed to fractures and floods, most geographers of a fair degree of training explain them more wisely as the result of slow sawing by the streams that flow through them; yet most geographers are still accustomed to adducing a canyon and not a peneplain in evidence of the magnitude of the work that can be done by rain and rivers. There is therefore no more wholesome discipline for the field geographer than to insist on the necessity of explaining every part of the land form that comes under his observation. His courage in this respect should be whole-souled rather than half-hearted; and whatever difficulties he may encounter, the success already attained should strengthen his resolution to pursue his task until complete success is reached.

9. *Explanation involves Past History.*—It is evident however that an explanatory method of description involves the consideration of the past history through which land forms have come forward to their present estate; and thus the subject of physiography gains a strong savor of geological methods. Some geographers seem to be disconcerted by this consequence of the explanatory treatment. They appear to think that description through processes of origin involves too serious a trespass on the field of geology, and they therefore give explanation over to the geologist. But there is nothing novel in the trespass of one science upon the methods of another. The chemist is constantly employing physical methods; the astronomer is as constantly employing mathematical and physical methods. Hence no apology is needed if the geographer employs geological methods whenever they serve his purpose. The real point is that these geological methods serve a geographical purpose; the purpose, namely, of aiding the observation and description of land forms, for which the geographer is primarily responsible. Any methods that aid this end are appropriate. Much attention as the geographer may give to process and time as involved in the sculpture of land forms, his interest in these geological elements is not aroused simply from the hope of tracing out the sequence of events that the past contains, but from the expectation, well warranted by abun-

dant experience, of being better able to treat existing land forms by a rational instead of by an empirical method. It is the geologist who studies the past history of the earth as an end in itself; it is his duty to unravel all the tangled skeins of earth history, however far back they may lead him. The geographer is concerned with the past not as an end but as a means to an end; and he cares only for so much of it as shall serve his present needs.

10. *Value of Ideal Geographical Types.*—The addition of explanation to the responsibilities of the geographer brings with it the need of idealizing actual forms into type forms, for it is chiefly in terms of type forms that actual forms are in fine described. This is also a discouragement to geographers of the more conservative school, who have thought that geography was concerned only with matters of fact, immediately observable. They must however come to see that direct observation is entirely insufficient for the geographer's needs, for the simple reason that if he recorded only what he saw he would be overwhelmed with ungeneralized items. He must generalize in order to bring the observable items within the reach of descriptive terms, and as soon as he generalizes, the use of idealized types is practically unavoidable. Such types have long been in current use, but they have been too few and too empirically defined for the best results. They need to be greatly increased in number, and at the same time they must be correlated with structure, process and time; for only by following the path of nature's progress can we hope to store our minds with types that shall imitate nature's products. It may be fairly urged that the larger the store of types a geographer possesses, and the more careful and numerous the comparisons with nature by which the types have been rectified, the better progress can the geographer make in new fields of observation.

11. *Service of Deduction in Geography.*—But the geographer who adopts the explanatory methods in a whole-souled fashion will find himself called upon not only to imagine a large series of type forms; he must also call into exercise his deductive faculties and employ them to the fullest, if he would make the best progress in the newer phases of his subject, however purely inductive he has imagined it to be. In setting up a store of types, there is need of deducing one type from another at every step; and it may be confidently urged that whoever hesitates to recognize this principle will fail of his effort to describe through explanation. But as a

matter of fact, geography has some time been more deductive than geographers have supposed it to be; and the newer phase of the science is not characterized so much by introducing deduction for the first time, as by insisting on its whole-souled acceptance as an essential process in geographical research.

It is only by giving the fullest exercise to the faculties of imagination and deduction that the cycle of erosion becomes serviceable. Here the geographer who hesitates is lost. Not only should the ideal cycle be followed in imagination through all its gradual changes on a large variety of structures, but the special cycles of arid and of frigid climate must be similarly treated; and then each of these cycles must be broken up by earth-movements into partial cycles and episodes. It is only in this way that the scheme of the cycle gains a serviceable elasticity; and it is highly significant that among those geographers who find the conception of the cycle unfruitful is one who has, with more candid indication of his unexercised imagination than he may have supposed, likened it to a "strait jacket."

Those who have not attained some fluency in the verbal translation of the various stages of normal and special, simple and interrupted cycles can have little understanding of the practical aid that is derived from this method of description. The empirical geographer, unsupplied with a store of carefully imagined and well-defined type forms, sees only what is before him in the field—if indeed he sees so much as that. The geographer who calls the faculties of imagination and deduction to his aid, draws from his mental store one type after another in the effort of matching the explained ideal forms with the actually observed forms. Thus comparing the partial view of the landscape, as seen by his outer sight, with the complete view of the type as seen by his inner sight, he determines, with great saving of time and effort, just where his next observations should be made in order to decide whether the ideal type he has provisionally selected fully agrees with the actual landscape before him. When the proper type is thus selected, the observed landscape is concisely and effectively named in accordance with it; and description is thus greatly abbreviated. It goes without saying that this relatively advanced stage of investigation is not to be reached hastily; that abundant and elaborate description of actual and of type forms in empirical terms, without a trace of explanation, should be demanded of the tyro who aspires to become an

expert; for in no other way can proper training in the use of types be secured.

12. *Contrasts of Biological and Physiographical Classifications.*—It may be worth while to note explicitly that there is little resemblance between the basis of the physiographic classification of land forms, here outlined, and the phylogenetic classification of organic forms now in vogue. In the latter case resemblance is inherited by actual derivation from common ancestors; and if similar forms arise as a result of similar environment, independent of relationship by descent, this only serves to emphasize the rule by pointing to the exception from it. In the former case, resemblance is due to repetition of physical conditions, and inheritance naturally has no part to play. Similar structures, acted on by similar processes, at similar rates for similar times will have similar forms; but as structures, processes, rates and times are all variable, it is not to be expected that identical forms should be developed. All the more need, therefore, of developing a method of rational generalization, whereby the essential features of a landscape may be seized upon as the basis for its description, while the insignificant elements of a landscape may be set aside. It should further be noted that while hybridization is of very limited range among organic forms, there is no limit to it in land forms. All sorts of structures are combined in all sorts of ways and acted on by all sorts of processes at various rates for different periods. This is indeed one of the chief causes of difficulty in physiographical description. Without free crossing of species, the variety of landscape would be much lessened. Physiography would then be easier and less interesting than it is now.

13. *Examples of Explanatory Description.*—The flood-plain scrolls illustrated in Fig. 1 may be instanced as examples that come very easily under the explanatory description of land forms. It has been ascertained with a high degree of certainty that a winding river, revived to renewed downward corrosion by the uplift of its basin, will increase the radius of curvature of its bends and push every bend down-valley while it is cutting down to grade with respect to its new baselevel. If the river had a meandering course when the uplift occurred, the increased width of the meander belt will be shown by the gentle slope of the spurs that enter each meander, as well as by the abrupt bluffs by which each meander is enclosed; while the down-valley advance of the meander system will be shown by the extension of the enclosing bluff with decreas-

ing height along the up-valley side of each spur, so that the spurs have an unsymmetrical cross section as shown in the figure. No flood-plain is developed before grade is reached; but as soon as this delicately organized condition is attained, further valley deepening is practically stopped, although the meander belt continues to widen, and the curves continue to advance slowly down-valley. As a result, narrow strips of flood plain in scroll-like patterns must be developed; a scroll will begin by lapping around the end of a spur; it will then follow along the gentle slope on the down-valley side of the spur and end with reversed curvature shortly after reaching the next enclosing bluff. As time goes on, the spurs are more consumed and the scrolls are widened. The spurs may be trimmed into sharp cusps, and later reduced to blunt cusps, and then the scrolls must have widened into shield-like patterns. As the river swings more and more freely and opens a valley floor of greater breadth than the meander belt, the separate flood-plain shields are joined; further than this we need not trace them here.

Now it is not conceivable that geographical items as systematic as these flood-plain scrolls should be treated empirically, after their origin and their development has once been made out. It suffices in describing the meandering part of the valley of the North Branch of the Susquehanna to say that it has reached the stage of narrow flood-plain scrolls; for on saying this, the sloping spurs and the enclosing bluffs at once come to mind as elements of form that are necessarily correlated with the flood-plain scrolls. The meandering valley of the Rance in Brittany shows a succession of narrow scrolls in the most orderly arrangement. The valley of the lower Seine by Rouen possesses broader scrolls; nearer the river mouth, where the tides run strong, the spurs are greatly reduced. The curving valley of the Evenlode, a diminished headwater of the Thames system in the Cotteswold hills of England, has sharply trimmed spurs which prove that the Evenlode was not beheaded until a somewhat advanced stage of valley development was reached. The diminished stream now straggles irregularly about the open valley floor. The valley of the Lot in southwestern France may be described as having nearly reached the stage of consumed spurs in one cycle, when a moderate elevation introduced a new cycle in which the stage of wide scrolls is now reached. The essential features of the valley are thus concisely indicated, although many individual variations from the suggested type are to be found.

14. *Distinction of Geography from Geology.*—If the explanatory method is adopted as appropriate for the physiographic description of meandering valleys in the narrow scroll stage, the same method should be adopted for all other stages of valley carving and for all other land forms as well. The orderly action of natural processes through a portion of past time is implied in such a phrase as "the narrow scroll stage," and it is similarly implied in saying that the Alleghenies of Pennsylvania are of corrugated mountainous structure, essentially baseleveled in a former cycle; then broadly elevated and thus standing long enough for the weaker strata to be etched out as lowlands, leaving the harder strata to stand up as even-crested ridges; and then again moderately elevated long enough ago for the valley lowlands to have now reached a submature stage of dissection. The descriptions of the Susquehanna valley and of the Pennsylvania Alleghenies differ in the quantity of past process and of past time involved; but such a difference is only of degree, not of kind. If all the stages of development through which the Pennsylvania Alleghenies have passed are traced out for their own sake, as much attention being given to one stage as to another, then the study is truly geological. If the changes of the past are introduced only in so far as they illuminate the present, and with no other object than to secure such illumination, then the study is geographical. It would be as much a mistake to regard such study as geological as it would be to say that a chemist is studying physics when he uses a balance to weigh a precipitate, or that he is studying mathematics when he calculates atomic weights. He is truly enough for the time employing physical and mathematical methods, but he is studying chemistry. It would be no more just to regard the explanatory description of flood plains as belonging under geology because it has to deal with past time, than to treat it as belonging to the study of physics because it involves the application of physical principles in the flow of a stream, in the corrosion of its bed and banks and in the transportation and deposition of detritus; and surely it would be no more appropriate to regard such a study of flood plains as a part of physics than it would be to take away the spectroscopic study of the stars from astronomy.

15. *Dangers of Explanatory Description.*—It is sometimes objected that the explanatory method of description is dangerous, because the observer who seeks to add explanation to observation

may be led to think that he sees things that do not exist. There is certainly some danger of this kind, but it can be greatly lessened by good training—without which the explanatory method is indeed valueless—and in compensation for the little danger that remains, there is the great increase in the thoroughness and accuracy of observation that results from bringing forward the various idealized types to be confronted with the facts in the field. If doubt finally remains, it may be expressed by the phrase, "as if":—The Susquehanna valley looks as if it were in the stage of narrow flood-plain scrolls. The initiated reader is thus concisely put in possession of the most probable conclusion as well as of the doubt that accompanies it. As a matter of practical experience, it may be urged that the gain from attempted explanation far outweighs its danger; and in illustration of this conclusion reference may be made to the curious case of the Connedogwinet, a branch of the main Susquehanna opposite Harrisburg. The branch has an unusually serpentine course, and the tangents between its curves are of extraordinary length. On visiting it in the spring of 1901, I expected that it would show normal narrow flood-plain scrolls; but as a matter of fact, its scrolls were found to be distinctly abnormal, inasmuch as they are nearly all on the down-valley side of the tangents. Truly, this is not a matter of great geographical consequence; the farmers would cultivate the scrolls, on whichever side of the tangents they might lie; but it is certainly of some physiographical interest to note their abnormal position, because it contradicts a generalization that is well supported by the repeated occurrence of examples in various parts of the world; a generalization that is fully explained by simple processes, perfectly accordant with the laws of stream flow. No explanation of the abnormal situation of the Connedogwinet scrolls has yet been suggested; indeed, as far as I have read, no mention of them as abnormal features has ever been made. Their peculiar arrangement seems never to have been noticed until it was brought out as an exception to the rule of flood-plain development. This example may therefore be taken to show that, far from there being serious danger of seeing imaginary facts by the light of theoretical explanation, a well defined conception of ideal types is a positive aid in correct observation.

16. *Framework of Physiographic Classification.*—If the explanatory method of physiographical description were adopted, it would result in the construction of a mental framework on which all

imaginable types would find their appropriate place in a systematic arrangement. Each of these types might be considered to be the label on a pigeon-hole ; and actual examples would be placed in their appropriate pigeon-hole as fast as they were collected. The compartments designed for common examples would soon be filled ; while others might long remain empty. Such a plan as this greatly promotes systematic observation, for the very fact that a certain pigeon-hole contains no actual form corresponding to its idealized type urges the observer to search for the missing example in districts where its occurrence is most probable. Revision of an idealized type would naturally be made whenever an example resembling it was found ; for however deductive the method of developing types may seem when here stated in the abstract, the actual progress of this sort of study involves repeated oscillations between induction and deduction, in which each process aids the other. The types are therefore not to be thought of as fancy pictures, unreasonably constructed by an ungoverned imagination and arbitrarily fixed by obstinate deduction. They should be the very best imitations of nature that the well-trained mind can construct, and they should be held subject to constant revision and correction as fast as observation is extended.

The conservative geographer will hesitate to construct a framework in which his types shall be more numerous than his examples. Indeed it sounds at first rather presumptuous to say that the variety of idealized types can exceed the variety of nature ; but there is no doubt that it can. The earth is after all not so very large ; and when all the examples of physiographic items that it contains shall have been studied out and systematically arranged, it will be easy enough to construct imaginary types that belong between two actual examples. Even if all the items that have existed in all the paleogeographies of the earth's history were brought into systematic arrangement, it may be doubted whether they would fill all the pigeon-holes of a well-imagined framework, so easily can the imagination conceive of a type intermediate with respect to any two neighboring examples.

It is therefore plainly a profitable exercise for the systematic geographer to elaborate his systematic framework as far as possible ; to increase the number of its little compartments, each bearing an appropriate label ; to arrange all the compartments in as systematic an order as he can develop ; and to devise every means—verbal,

graphic or mechanical—by which the framework shall always be at his service for practical use. Its value will increase with every step that is taken towards a vivid realization of its imaginary contents. It may seem cumbersome as long as it is unfamiliar; but when it is familiarly known it becomes an indispensable aid in practical work.

17. *Complexity of Geography.*—The whole current of thought changes when the ontographic half of geography is taken up. The training that is here necessary must be gained largely through biological study, while the training for the study of the earth as a globe is associated with astronomy, for the atmosphere with physics, for the oceans with hydrostatics and hydrodynamics, for the lands with geology. Whether this diversity of discipline is an advantage or not need not be answered; it is certainly a necessity. It is perhaps true that geography has, by reason of its many-sidedness, a more complex content than any other science; but if so it merely occupies a rank that would be otherwise held by some other subject; and certainly there is no impropriety in standing at either end of the list in this respect. Astronomy ranks well among the sciences, yet it now calls for mathematical, physical and chemical discipline; and if the change of color on the face of Mars follows his seasons it may be necessary to add a biological discipline as well.

Some have feared that the various parts of geography might fall asunder from their diversity of content and of discipline. So they undoubtedly would, but for the bond of relationship that holds them so strongly together. It may perhaps come to be wise for the geographer to follow the example of those engaged in other sciences and limit his attention to one part of his subject. Just as there are mathematical and physical astronomers, inorganic, organic and physical chemists, students of ancient, modern and many other groups of languages, so there may advisedly be physiographers and ontographers, instead of geographers; but all this is of secondary importance. Geography certainly has its inorganic and its organic side, and both must be understood by any one who would claim to be a thoroughly trained geographer, versed in the relationships by which the physiographic and ontographic sides of the subject are held together. The reason that so few persons can to-day rightly claim such standing is not so much because there is any inherent difficulty in the subject on account of its breadth and its complexity,

as because the subject is not maturely developed; but this is an aspect of the question that I shall elsewhere consider.[1]

18. *Relation of Physiography and Ontography.*—Unlike physiography, which has been recognized as an essential constituent of geography for many years past, ontography has to-day hardly gained an established position. It is best represented in Ratzel's *Anthropogeographie*, but this subdivision of the science is concerned only with the human element, and that is manifestly but a part of the total content of ontography. It is approached in ecology, but none of the many definitions of that term cover all that is here intended, for ontography is meant to include all the responses of organic forms to their physical environment, whether in physiological structure, in individual behavior, or in racial habits. Whether there is need of this new term, whether it will survive or not, it serves a present purpose in bringing clearly forward the organic half of the geographical whole.

The subdivision and classification of ontography has not yet been well accomplished. Before it can be well done, there must be much searching; but we may look forward to a time when all ontographic items shall be arranged on an ontographic framework, in which every compartment shall have for a label what biologists might call a type response. I am persuaded from much profitable experience with the physiographical framework that a corresponding advantage will come from the construction and familiar use of a similiar framework for ontography. Still more: the two frameworks might be brought face to face, and lines might then be drawn between them, connecting cause with effect, effect with cause. If then a plane were passed secant to all these lines of relationship, all the content of geography might be projected along the lines upon it. If the plane were placed near the physiographic framework, there would be groups of points, where numerous radiating lines departing from some dominant physiographic control pass through the plane on their way to various ontographic effects. If the plane were passed near the ontographic framework, the grouping of numerous points of intersection would serve to indicate those organic forms which respond to many physiographic controls, while isolated points would indicate forms that respond to few. Accord-

[1] National Association for the Scientific Study of Education, Proceedings of the Minneapolis Meeting, July, 1902.

ing therefore as the geographical plane is placed nearer to one framework or to the other, the presentation of the total subject might be made primarily physiographic and secondarily ontographic, or the reverse.

19. *Subdivisions of Ontography.*—It is not an ontographic classification, but the nature of such a classification that can here be set forth to best advantage. There should be two chief subdivisions; the first includes those responses that were initiated ages ago and maintained by inheritance till to-day because their controls are persistent; the second, those of relatively recent origin. Further subdivision might be made in accordance with the standard classifications of botany and zoölogy, in which the responses of all kinds of plants and animals to physiographic controls would be taken up in their natural order. But in view of the repetition of similar responses in many different classes of organisms, it will be here more convenient to follow a physiographic order in the ontographical classification. Examples of long-inherited responses will be mentioned first.

As inhabitants of an earth whose mass is very much greater than that of all its organic population, plants and animals very generally show a response to the action of gravity in their attitudes as well as in their structure. As inhabitants of an earth whose opaque surface is illuminated from without, the distribution of color in plants and animals is often closely associated with the response to the downward action of gravity. As occupants of an earth whose surface is nearly globular, plants and animals have been allowed a much wider migration than would be possible for the occupants of a very irregular body, on whose surface gravity would vary greatly. None of these responses are doubtful as to origin or difficult as to comprehension; they ought to be introduced in the elementary study of the earth as the globe; and their almost universal omission from that chapter of geography affords immediate illustration of the little thoroughness with which the subject is treated. Perhaps these matters have been omitted because they are regarded as of less importance than the names of the branches of Siberian rivers; but if so, a very singular standard for the measure of importance has been accepted. Many other long-inherited responses to the physical features of the earth as a globe might be instanced, but space is lacking for their presentation.

One of the most universal of all organic habits, that of breathing

free oxygen, must be regarded as the long-inherited response to the presence of oxygen in the free state, whether mixed with other gases in the atmosphere or dissolved in the waters of the ocean. Organs of flight, to-day characteristic of many insects and birds, are extraordinary devices for movement through the air; this may seem a valueless truism to some, but it must be explicitly stated if the ontographic framework is to be thoroughly constructed, and if conscious attention is to be aroused to it. Vocal organs are responses to the extreme eclasticity of the air; human speech may be reckoned among the responses of modern acquisition under this class. The adoption of blue as one of the primary colors of the spectrum is a modern response to the color of the sky; a physiographic fact that has waited long for its ontographic mate. Pollen grains, spores and innumerable microscopic organisms of great importance in the economy of the nature, exhibit in their minuteness a response to the small sustaining power of the winds that bear them about. If climate were here considered as well as these simpler physiographic features of the atmosphere, the number of ontographic responses in this class would be greatly increased.

The greater buoyancy of water than of air has a notable response in the absence of feet among most of the swimming animals of the ocean. The flying animals of the atmosphere, on the other hand, always have legs to sustain them when they alight on the ground from the little sustaining air. The same contrast between water and air must account for the much greater size of the floating inhabitants of the ocean than of the blown-about organisms of the atmosphere. While the more opaque animals of the sea usually have a darker dorsal and a lighter ventral surface, many of the floating animals find relative safety in imitating the transparence of the waters in which they float. It is the monotony of the cold, smooth, dark and quiet ocean bottom that has doomed it to be the home of the less intelligent organisms, while the variety of the lands has promoted the development of the most remarkable instincts and the highest intelligence among their inhabitants.

The separation of the lands into several large continental masses has led to the division of mankind into races; and closely associated with this division into races go many peculiarities of government, religion and degree of civilization. All this is most intimately connected with that phase of ontography commonly called political geography; and yet so arbitrary and irrational is

the traditional classification of geographical topics that the division of mankind into races is commonly taught under physical geography. The races may be fairly enough introduced there as illustrations of ontographical consequences following from physiographical controls; but to regard them as essentially physiographic topics shows a regrettable failure to recognize the essential quality of geographical discipline.

The simple physiographic factor of distance is of great importance. It involves the separation of the people of a race into many families, and thus is a determining cause of difference of language and of many other habits. The unevenness of surface exhibited in mountain ranges is of small measure in comparison to the dimensions of the earth, and yet it suffices to make movement so difficult that the occupants of one valley may have a distinctly different dialect from those in a neighboring valley. How circumscribed would have been the migrations of the earth's inhabitants if the height of mountain ranges were a large part of the earth's radius! The sheet of loose rock waste by which the lands are so largely covered not only supports the growth of plants, but has been adopted as a home by many kinds of animals; and according as the waste is a coarse talus lying on the steep slopes of a young mountain side, or a fine, deep soil blanketing a peneplain, its occupants are of different kinds. Instances of this kind might be extended without number.

Examples of modern responses to physiographic controls are best found in those new-fashioned characteristics of mankind that are seen in sites of settlement, routes of travel, and in the development of trades and of commerce.

Settlements in deserts offer particularly striking illustrations of the dependence of population on water supply. Settlements on rivers are largely determined by head of tide, by falls, and by fords. Settlements on coasts are influenced by protection from the open sea, and by ease of access from sea and land. The routes of trade and commerce are guided by physiographic factors literally at every turn. Straight roads are laid out on plains, but winding valleys are commonly followed in regions of strong relief; tunnels are driven through mountains; short-cuts are made through isthmuses. Here as before, illustrations are endless; yet abundant as they may be, they have not yet been well classified. At the present day, ontography is less developed than physiography.

Many examples are individual rather than generic. It was the shoals remaining where morainic islands once arose that turned the Mayflower northward from a course that might have led her south of Cape Cod to New Amsterdam ; it was the greater height of the mainland where the moraines of Manomet were piled upon it that led the Pilgrims from their first landing at Provincetown to the quiet harbor of Plymouth. The varied course of human history affords innumerable examples of this kind. It would be profitable to make a long list of them, to classify the items thus gathered, and to select the best examples of various classes for presentation as types. A geographer who was well informed regarding such types would undoubtedly be more observant in his travels than many travelers are to-day. He would be continually asking questions and finding answers where he is now silent.

20. *Regional Geography.*—It is in the prevalently unsuccessful treatment of regional geography that the undeveloped condition of systematic geography is made most apparent. It is well recognized in the organic sciences that only after a general understanding of systematic botany or systematic zoölogy is gained can a profitable attempt be made to describe the flora or the fauna of a limited district. The same principle undoubtedly obtains in geography ; yet nothing is more common in geographical literature than an attempt to treat the geography of a certain region before any thorough system of geography has been agreed upon. This error is in the way of being corrected, but it is still a prevalent error. In texts on physical geography, for example, it is still common to find an attempt made to describe the physiographic features of the several continents before any sufficient understanding has been gained as to the nature of physiographic features. The year of study commonly allotted to this subject in the schools is none too long for a sound systematic course, and by no means long enough for the addition of a regional course as well. Systematic physiography may be vivified by the introduction of many well-selected examples from various parts of the world, but there is not time in a single year to present a substantial account of the continents or even of a single continent in addition to the systematic account of the whole subject.

21. *Conclusion.*—The practical conclusion of all this is that it is the nature of geography as a whole, rather than the accumulation of unassorted and uncorrelated items, that demands the attention of

geographers. Careful analysis and arrangement of the content of the subject is as greatly needed as the exploration of unknown lands. It must be remembered, however, that the object of analysis and classification is to render practical aid in the understanding of geographical items, old and new. There should be no hindrance placed in the way of the active pathfinders who seek to enter unknown lands; but there should be every encouragement given to those who believe that some of the unknown elements of geography may be discovered without going far from home.

Stated Meeting, April 18, 1902.

President WISTAR in the Chair.

Present, 16 members.

Letters accepting membership were read from
Dr. John A. Brashear, Allegheny, Pa.
Dr. Andrew Carnegie, New York.
Prof. William B. Clark, Baltimore.
Dr. Hermann Collitz, Bryn Mawr, Pa.
President Arthur T. Hadley, New Haven.
Prof. George E. Hale, Williams Bay, Wis.
Dr. C. Hart Merriam, Washington.
Prof. Theodore W. Richards, Cambridge.
Prof. Felix E. Schelling, Philadelphia.
Prof. Robert Henry Thurston, Ithaca, N. Y.
Prof. Robert S. Woodward, New York.

Mr. Thomas Willing Balch presented, on behalf of his brother and himself, the MS. account book of the first "Philadelphia Assembly," 1748, and read a note thereon.

Mr. Alden Sampson read a paper on "The Ruins of Palmyra, with a Brief Consideration of the Ancient Estate of that City."